EVIDENCE OF PORTUGUESE STOCK MARKET ABNORMAL RETURNS

Elisabete Mendes Duarte (elisabete.duarte@ipleiria.pt)
Lisete Trindade Oliveira (oliveira.lmt@gmail.com)
Superior School of Technology and Management of Leiria
CIGS – Centro de Investigação em Gestão para a Sustentabilidade
Polytechnic Institute of Leiria- Campus 2
Morro do Lena - Alto do Vieiro
2411 - 901 Leiria (Portugal)

ABSTRACT:

According to the stock market efficiency theory, it is not possible to consistently beat the market. However, technical analysis is more and more spread as an efficient way to achieve abnormal returns. In fact there is evidence that *momentum* investing strategies provide abnormal returns in different stock markets, Jegadeesh, N. and Titman, S. (1993), George, T. and Hwang, C. (2004) and Du, D. (2009). In this work we study if like other markets, the Portuguese stock market also allows to obtain abnormal returns, using a strategy that consists in picking stocks according to their past performance. Our work confirms the results of Soares, J. and Serra, A. (2005) and Pereira, P. (2009), showing that an investor can get abnormal returns investing in *momentum* portfolios. The Portuguese stock market evidences *momentum* returns in short term, exhibiting reversal in long term.

KEY WORDS: *Momentum* investing, abnormal return, Portuguese stock market.

EVIDENCE OF PORTUGUESE STOCK MARKET ABNORMAL RETURNS

1. INTRODUCTION

Momentum investing strategies consist in buying assets that have presented higher performance (winner) in previous periods than the reference market index and hold them for periods from one month to one year. Several authors consider also a strategy consisting in short selling assets with lower performance (losers) than the market. The investor assumes that the assets with high (low) performance in the previous short term period, will maintain the trend in next short term. The Market is not efficient in semi-strong form, and although it follows a random walk, it is possible to identify a path for the future asset market price.

In this work we investigated if Portugal's behaviour concerning *momentum* strategies is similar to the European and US markets and if it is possible to obtain positive outperforming returns in Portuguese market. We followed George, T. and Hwang, C. (2004) and Du, D. (2009)'s works. Is also a goal of our work to find which strategy provides the most profitable strategy in Portuguese stock market.

We focused on an active investment strategy - *momentum* investing – the underlying assumption is that stocks that have gone up the most in the recent past are more likely to go up in the recent future. Therefore, a buy-and-hold strategy, with a specific picking method will outperform market.

We replied Jegadeesh, N. and Titman, S. (1993), George, T. and Hwang, C. (2004) and Lo, A. and Mackinlay, C. (1990) *momentum* strategies to the Portuguese market, focusing on three main issues:

1. Do individual *momentum* strategies allows to outperform market in the Portuguese stock market?
2. Which *momentum* strategy is the most profitable in the Portuguese market?
3. Does the Portuguese market exhibit reversal in long-term?

The reminder of this paper is organized as follows. Section 2 makes a brief review of *momentum* related literature. In section 3 we present the empirical design of this work

with reference to data and methodology. The methodology is divided in three main parts: Jegadeesh, N. and Titman, S. (1993), (JT) and George, T. and Hwang, C. (2004) (52 WH) and Lo, A. and Mackinlay, C. (1990) (LM) strategy. In section 4 we present the main conclusions of this paper.

2. LITERATURE REVIEW

Behavioural finance theories advocate that some deviations in stock market prices from their fundamental value are driven by not completely rational stock market agent's behavior, Barberies, N. and Thaler, R. (2002). The anticipate knowledge of this investor's rational behaviour deviation, allows to anticipate the stock market prices path. Therefore, investors with knowledge of the most appropriated model will be able to achieve abnormal returns, without incurring in additional risks, Cahan, R. (2008).

Several studies have addressed *momentum* since Jegadeesh, N. and Titman, S. (1993) first showed that a portfolio constructed from a performance ranking of U.S. stocks during 1927 to 1964 period, buying the top 10% and short selling the bottom 10% provided a monthly return of 1%; and since Grinblatt, M. and Moskowitz, T. (1999) documented that individual *momentum* is driven by industry *momentum*.

Cerqueira, A. and Brandão, E. (2008) also showed evidence of *momentum* in the U.S. stock market. Their sample includes 10483 stocks, along the years of 1990 to 2006. Their work focused on the returns of portfolios made up from a formation period of six months and a holding period of six months (6,6). Following Jegadeesh, N. and Titman, S. (1993), their strategy consists in buying the 10% top performance stocks, and short selling the 10% bottom performance stocks, achieving a 0,98% average monthly return. The authors conclude that this anomaly first documented by Jegadeesh, N. and Titman, S. (1993) prevails over time and is not due to data mining.

Cerqueira, A. and Brandão, E. (2008) also conclude that in the sub period sample 2000 to 2003 (bear market period) the returns although smaller, are positive and not significantly different from the bull market period. They notice that the high returns, especially in bear market, are due to the contribution of loser portfolios.

In 2004, George and Hwang have presented an inovative strategy that consists in

picking the stocks ranked according to the smaller distance from their actual market price to their last year's maximum value (52 week high). Their sample includes U.S. stocks from 1963 to 2001. After controling size effect and bid-ask spread, the 52 week high strategy provided a 0,65% monthly returns, outperforming Jagadeesh and Titman (1993)'s strategy – providing a 0,38% monthly return.

Recently, Jannen, B. and Pham, V. (2009) replied 52 week high George, T. and Hwang, C. (2004)'s strategy, with different results. The *momentum* strategies considered outperformed market, but the 52-week high strategy was not the most profitable strategy when considering the top 500 capitalization stocks in the U.S. during 1998 to 2007. The authors concluded that the 52-week high strategy is a less efficient predictor, than industry *momentum* Grinblatt, M. and Moskowitz, T. (1999)'s strategy and Jagadeesh and Titman (1993)'s strategy. They developed a new strategy called regency of the 52-week high, that uses not only the proximity to the 52 week high, but also the gap of time till the maximum value in last year. They conclude that, for the sample, it is more efficient than any of the previous strategies.

2.1. PHENOMENUM UNDERLIYNG *MOMENTUM* STRATEGIES

Several authors suggested behavioral models to explain *momentum* anomaly in which *momentum* returns result from a sequential process of investors reactions to news. Accordingly, it is always caused by optimistic or pessimistic reactions to good or bad news, which drives the stock market prices to move away from its fundamental value. In long term, the stock prices tend to be corrected and move toward its fundamental value.

For instance, if investors are optimistic, in presence of good news, they will overestimate the impact on stock prices, causing pressure for prices to increase more than their fundamental value – the stock market overreaction hypothesis. This overreaction effect is temporary, and will be corrected in time. First it pulls away prices from their equilibrium value, but in time, prices will tend to return to their equilibrium value. All the existing theories of overreaction have in common the notion that price changes are negatively autocorrelated for some holding period, Lo, A. and Mackinlay, C. (1990).

Stock market overreaction allows some degree of predictability, but as in long term stock prices will tend to their fundamental value, the abnormal stock return will exhibit reversal and winners will become losers and losers will become winners. An investor's strategy consisting in going long on losers and short sell winners, holding this position till the reversal in returns, will allow to outperform market – The contrarian strategy. Several authors have proposed a different theory to explain the continuous path some stocks present, explained by a slowly movement toward the equilibrium value – The stock market underreaction hypothesis. Investors tend to have the irrational behaviour of anchoring their stock prices to a value. For some authors this is the purchasing price, with the jointed idea that the demand for stocks is positively correlated with capital gains. For Grinblatt, M. and Han, B. (2001) the anchor is also the purchasing price, but due to loss aversion, some investors are unwilling to acknowledge losses and hold stocks, waiting for prices to reverse.

George, T. and Hwang, C. (2004) strategy is based on the 52 week high anchor behaviour. Investors tend to consider stock prices float between their extreme values and question the new highs or lows, underreacting to news, only the confirmation of good or bad news will force stock prices to their fundamental value. When stock prices are near their high or low 52 week value, the anchor behavioral bias is deeper.

Jannen, B. and Pham, V. (2009) also points out the hypothesis that new highs cause underreaction to positive news. Related to the fear of reversal, investors tend to question if the actual price already reflects the news and if the new high is sustainable or not. Also speculators contribute to underreaction related to new highs. As the prices rise, the speculators tend to make capital gains. Both behaviors pressure prices down despite good news. The recent is the new high, the stronger the pressure down, although temporary. The prices will keep rising as good news is confirmed.

The under(over)reaction in short term is followed by over(under)reaction in long term Du, D. (2009). As we can find in Lo, A. and Mackinlay, C. (1990, pp.176) about behavioral *momentum* models, "investors are subject to waves of optimism and pessimism and therefore create a kind of "*momentum*" that causes prices to temporarily swing away from their fundamental values". Common to overreaction theory defenders

is always the empirical idea of autocorrelation on returns, and of returns reversal in long term.

Using a contrarian investing strategy, Lo, A. and Mackinlay, C. (1990) showed that the existence of overreaction is not required to get extra returns. About half of the obtained results through their specific strategy are attributable to cross-sectorial correlation and not to autocorrelation in returns. The authors also showed that this cross-sectorial correlation in returns is usually positive and has contagious effect to other stocks. Returns of small size stocks often follow the returns of large size stocks.

The *momentum* strategies efficiency is not exclusively driven by market overreaction. Following Lo, A. and Mackinlay, C. (1990), Du, D. (2009) found that an industry *momentum* strategy, considering all available assets in market consisting in going long on winners and short on losers, provide abnormal returns, not completely explained by autocorrelation in stock returns. Accordingly, long term *momentum* is driven mostly by cross-sectorial correlations, while short term *momentum* is explained by autocorrelations in returns. Short term *momentum* is not the manifestation of the same phenomenon that origins long term *momentum*.

Du, D. (2009)'s results are compatible with Jegadeesh, N. and Titman, S. (1993) and Lo, A. and Mackinlay, C. (1990) as the sample industry returns do not exhibit reversal in the first week and *momentum* continues in the following six months. He remarks that as industry portfolios are well diversified, his results show that *momentum* returns of industry and individual stock returns are not due to firm-specific risk, microstructure effects or data mining.

Reversal in *momentum* was contested by George, T. and Hwang, C. (2004). In their work, they showed that additional returns do not exhibit reversal in the following two years. Their results were later confirmed by Du, D. (2009).

2.2. *MOMENTUM* IN EUROPEAN AND PORTUGUESE STOCK MARKET

Momentum is a phenomenon widely studied especially in the U.S. Market. The European market, maybe due to its own individuality is not as widely documented on this subject. The long European history has carved a political chart with economic

characteristics very distinct from the U.S. large market. The European markets are smaller, some with less of 50 listed companies, which makes difficult the analysis of *momentum*, as it enables to consider well diversified industry portfolios.

One of the first works related to *momentum* in European market was conducted by Rouwenhorst, K. (1998). His sample contained 2190 listed stocks from 12 European countries, during 1978 to 1995. He followed Jegadeesh, N. and Titman, S. (1993)'s work, obtaining about 1% average monthly return for the analyzed markets, confirming that *momentum* returns do exist in the European global market and in individual European countries. The abnormal return related to *momentum* lasts for over a year and is not due to regional risk.

Also Nijman, T., Swinkels, L. and Verbeek, M. (2004) devoted their work to the study of European *momentum*. They suggest that in the European market, *momentum* is first motivated by individual stock *momentum* (about 60% of the total effect of *momentum),* secondly is driven by industry *momentum* (about 30%) and at last, driven by regional *momentum* (about 10%). As in Rouwenhorst, K. (1998), country characteristics are not determinative for European *momentum*.

Concerning the Portuguese stock market, there are several studies showing that the PSI 20 behaviour does not follow a random walk, it evidences heterocedasticity and autocorrelation Simão, J. (2000). The denial of returns autocorrelation inexistence hypothesis, implicates necessarily, some level of predictability in financial asset price fluctuation Lo, A. and Mackinlay, C. (1990). Thereby, Portuguese market is also open to the possibility of finding models that allow to predict future returns based on historical knowledge. However, as refered by Simão, J. (2000, pp15) "*O que não significa que se possa retirar, para já, ilações quanto à (in)eficiência do mercado (ou dos títulos). Para tal, é necessário investigar se a autocorrelação existente é suficiente para ser explorada em termos económicos.*"

Soares, J. and Serra, A. (2005) using several listed stocks in Portuguese market and considering a sixteen year period, investigate the existence of returns autocorrelations. They found evidence of *momentum* and conclude that returns of listed stocks between 1988 and 2003 evidence negative autocorrelation in long term. They have considered a

portfolio based on a ranking from the returns of last 24 months and holding them for another 24 months. Their conclusions support the overreaction hypothesis, even after controlling risk.

In short term, they get similar results to Jegadeesh, N. and Titman, S. (1993). Considering a (6,6) strategy, they achieve 0,38% average monthly return with the winner strategy and 0,73% average monthly return with the loser strategy (about 0,95% total return). These results are not significantly different from Jegadeesh, N. and Titman, S. (1993) results for the U.S. market into 1927 to 1964 period and Cerqueira, A. and Brandão, E. (2008) from 1990 to 2006. The results suggest that *momentum* anomaly is even stronger on losers than it is on winners.

Recently, Pereira (2009) has studied *momentum* returns in the Portuguese stock market. His sample was composed by listed stocks in EURONEXT, during January 1997 to December 2007. Considering five diferent portfolios from a performance ranking, the first one composed by the 20% top ranked stocks (winners), the second portfolio composed by stocks ranked between 60% and 80%, till the fifth portfolio having the 20% bottom performers (losers). He first went long in all five portfolios and conclude that winners allow an average monthly return of 0,69% superior than the losers. His top performance portfolios presented 0,75% and 0,68% average monthly return and the winner portfolios provide higher returns than the loser portfolios.

When considering only short term strategies for all sample period, the returns are even higher, clearly outperforming the PSI-Geral and the PSI-20. Investing in winners provide an average monthly return of 0,97%, although in the same period PSI-Geral gained in monthly average terms only about 0,55% and PSI-20 about 0,16%. Going long on losers (fifth portfolio) origins a loss of 0,16% . Considering 45 short/medium term strategies, the author concludes that all winner portfolios provide positive returns, while only 26 loser portfolios provide positive returns. Such results confirm that in short term, winners keep increasing and losers keep decreasing. "*In general, extreme loser stocks probably face financial distress and in the short-medium term they are not able to solve this problem, thus showing continuing underperformance"* Pereira, P. (2009, pp 21). His results prove the existence of *momentum* in the Portuguese market for the sample period.

The author divided his sample into three subsamples: 1997 to 2002 (corresponding to the dot.com crisis), 2003 to 2008 (excluding dot.com crisis) and 1997 to 2007 (excluding subprime crisis). He then concludes that the *momentum* strategy he used provides higher returns in bull market, as in monthly average terms, the results obtained when including dot.com and subprime crisis are smaller.

Pereira, P. (2009) also use an innovative strategy "que consiste na compra de acções, sempre que se verifiquem dois requisitos: a rendibilidade no mês precedente ao investimento tem de ser maior que *Js* (5% ou 10%) e nos meses anteriores a este mês a rendibilidade média tem de ser superior a *Jm* (30% ou 40%). Caso estas duas condições não se verifiquem, o modelo desenvolvido considera que é melhor investir a uma taxa de juro sem risco" Pereira, P. (2009, pp iv). The results did not outperform the first *momentum* strategy.

3. EMPIRICAL DESIGN

According to Simão, J. (2000), Portuguese market characteristics namely the returns autocorrelations, probably allows finding out a picking strategy to form portfolios which will provide abnormal returns without incurring in additional risk. Our work confirms Soares, J. and Serra, A. (2005) and Pereira, P. (2009) and shows that similar to Jegadeesh, N. and Titman, S. (1993), George, T. and Hwang, C. (2004) and Jannen, B. and Pham, V. (2009) for U.S. market, *momentum* strategy in Portuguese portfolios do outperform market return without taking additional risk.

3.1. DATA

The information was gathered from DATHIS software at EURONEXT Lisbon. We have collected the daily closing values for every listed stock in PSI-Geral from 31/12/1999 to 31/12/2009, adjusting prices for dividend and splits. We also gathered information about closing values of both reference indexes for Portuguese stock market PSI-Geral and PSI-20, which we used as a proxy of market return. We excluded from the sample, stocks that had more than twenty consecutive days without transactions between quotations, in order to remove stocks that although listed, had no liquidity. We also

excluded stocks listed for less than six months. In cases closure prices were not available (days without transactions) we have estimated the closing value. The sample includes 59 listed companies.

The small size of Portuguese market does not allow considering industry *momentum* so, we will focus on individual *momentum* returns only.

3.2. *MOMENTUM* STRATEGIES RESULTS

The first decade of the century was marked by two distinct recession periods, the international dot.com crisis in the first years of the decade and the subprime crisis in the end of the decade, having a contagious effect in the European markets and, of course in the Portuguese market. They strongly affect financial environment, having the majority of markets registered strong losses making the reference indexes to recess. Portuguese index was not an exception, having the PSI 20 underweighted over 34,58%. In 31 of December 1999 the closing value was 11960,51 base points and ten years later the closing value was 8463,85 base points. The PSI-Geral, being less volatile, possibly due to the reduced liquidity of some listed stocks, performed better than the PSI-20, valuing 6,436 % between 31/12/1999 and 31/12/2009.

Figure 1 – PSI-20 and Psi-Geral evolution from 2000 to 2009

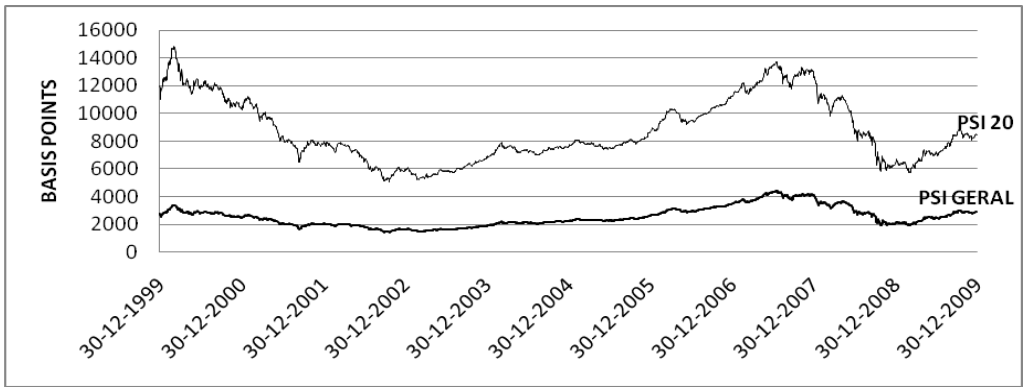


Table 1 – Percentage evolution of PSI-20 and Psi-Geral from 2000 to 2009

Index	Closing prices		Total	Monthly average
	31-12-1999	31-12-2009		
PSI-GERAL	2732.36	2914.01	6.44%	0.0520%
PSI-20	11960.51	8463.85	-34.58%	-0.3530%

Our results confirm the seminal work of Pereira, P. (2009) for Portuguese stock market, although the extents of returns are lower in present work. This difference might be due to the different time line of each sample. During Pereira, P. (2009)'s sample term, the PSI-20 gained about 0,16% per month and the PSI-Geral almost 0,55% per month and during our time line term, the indexes performances were lower.

3.2.1. JEGADEESH, N. AND TITMAN, S. (1993) (JT)

Every week a portfolio was formed from a past return ranking of J formation months. The strategy consisted in buy the stocks that belong to the top decile, the winners (W) and short sell the stocks that belong to the bottom decile, the losers (L). Every month, we ranked the returns considering a formation period of 1, 3, 6, 9 and 12 months. Each portfolio was hold by K months (11, 3, 6, 9, 12, 15, 18, 21 and 24).

As Jegadeesh, N. and Titman, S. (1993), Cerqueira, A. and Brandão, E. (2008) and Pereira, P. (2009), among others, we used overlapping periods. For example, considering an investing period of one year, and holding period of six months, we have six portfolios (with holding period January-June, February-July, March-August, …, July-December). This allows us to obtain a maximum number of portfolios.

For every stock, the return is:

$$r_{i,t-1} = Ln(\frac{p_{i,t-1}}{p_{i,t-(J+1)}})$$

Where $r_{i,t}$ is the return of stock *i* in month *t*, $p_{i,t-1}$ is the price of stock *i* in last day of month *t-1* and $p_{i,t-1}$ is the price of stock *i* in last day of month *t-(J+1)*. The top 10% return stocks were called winners, and bottom 10% return stocks were called losers. JT

strategies consist in a buy and hold strategy and every month *t* go long on winners and short sell the losers, holding the portfolios for *K* months.

We confirmed the existence of *momentum.* Most of the individual strategies beat the market, and from the 45 pointed strategies, the 25 most profitable present an average monthly return higher than 1%. Only the strategies (12,21) and (12,24) have negative returns of -0,125% and -0,215% respectively. The most profitable strategies are the short term ones, with formation periods of 1, 3 and 6 months, with holding periods till one year, containing the 11th most profitable strategies. The (1,1) strategy has the best performance with average monthly return of 1,667%, followed by strategies (3,1) and (3,3) with average monthly returns of 1,658% e 1,636%. Despite being the most profitable strategy (1,1), the formation periods of 3 and 6 months present more consistent results. The 2th, 3th, 6th and 8th best strategies are for *J*=3 and *K*=1, *K*=3, *K*=9 e *K*=12 respectively. For *J*=6 we find the 4th, 5th, 7th and 9th most profitable strategies.

Table 2 – Average monthly returns provided for Jegadeesh, N. and Titman, S. (1993) strategy in the Portuguese stock market from 01/01/2000 to 31/12/2009. The strategy consists in going long on the 10% top performer stocks (winner) and short sell the 10% bottom performers, according to a ranking of returns considering historical data of J months (formation period) and holding the portfolios for K months.

Portfolio		**Winner (W)**	**Loser (L)**	**Total return W+L**
J=1	**K=1**	0.41%	1.26%	1.67%
	K=3	0.37%	0.94%	1.32%
	K=6	0.31%	0.77%	1.08%
	K=9	0.26%	0.87%	1.13%
	K=12	0.20%	0.88%	1.08%
	K=15	0.19%	0.79%	0.98%
	K=18	0.22%	0.71%	0.93%
	K=21	0.20%	0.56%	0.76%
	K=24	0.19%	0.45%	0.64%
Portfolio		**Winner (W)**	**Loser**	**Total return**

			(L)	W+L
J=3	**K=1**	0.66%	1.00%	1.66%
	K=3	0.57%	1.07%	1.64%
	K=6	0.42%	0.98%	1.39%
	K=9	0.34%	1.13%	1.47%
	K=12	0.34%	1.09%	1.43%
	K=15	0.36%	0.95%	1.31%
	K=18	0.36%	0.87%	1.22%
	K=21	0.32%	0.60%	0.92%
	K=24	0.32%	0.51%	0.83%
J=6	**K=1**	0.57%	0.98%	1.55%
	K=3	0.43%	0.97%	1.40%
	K=6	0.38%	0.99%	1.37%
	K=9	0.40%	1.09%	1.49%
	K=12	0.45%	1.01%	1.46%
	K=15	0.37%	0.86%	1.22%
	K=18	0.26%	0.63%	0.89%
	K=21	0.21%	0.40%	0.61%
	K=24	0.19%	0.25%	0.44%
J=9	**K=1**	0.19%	1.14%	1.33%
	K=3	0.50%	0.82%	1.32%
	K=6	0.43%	0.88%	1.31%
	K=9	0.48%	0.88%	1.37%
	K=12	0.39%	0.81%	1.20%
	K=15	0.31%	0.62%	0.93%
	K=18	0.22%	0.45%	0.66%
	K=21	0.15%	0.27%	0.42%
	K=24	0.13%	0.10%	0.23%
J=12	**K=1**	0.13%	0.86%	0.99%
	K=3	0.32%	0.71%	1.03%
	K=6	0.33%	0.65%	0.97%

	K=9	0.41%	0.61%	1.02%
	K=12	0.28%	0.49%	0.77%
	K=15	0.18%	0.41%	0.59%
	K=18	0.04%	0.22%	0.25%
	K=21	-0.03%	-0.09%	-0.13%
	K=24	0.00%	-0.21%	-0.22%

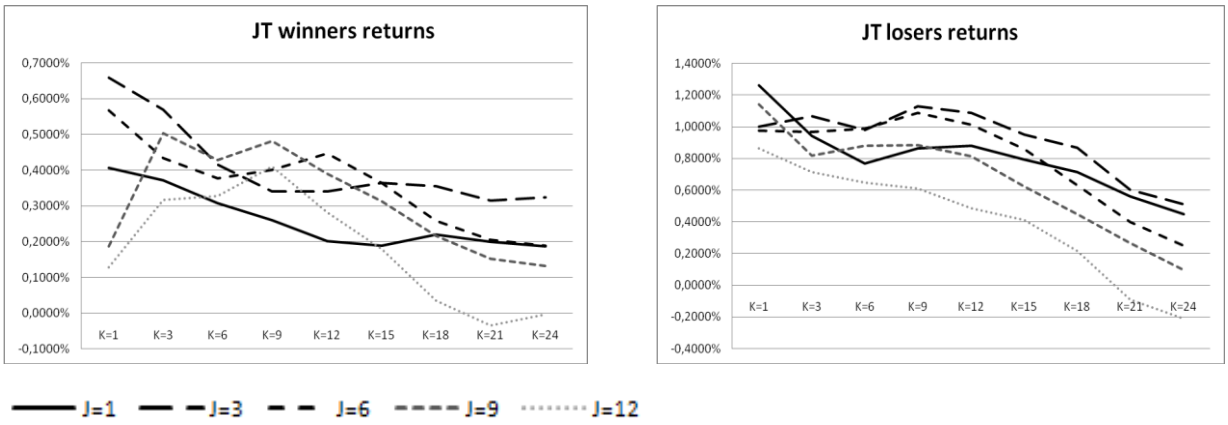
The most efficient strategies have both *K* and *J* smaller than 12, except strategies (1,18), (3,18) and (6,12). Most winner strategies outperform both PSI-20 and PSI-Geral (except strategies having J=12 and K≥ 18).

The most effective winner strategies are the ones having *K* and *J* smaller than one year. Most winner strategies beat the market. Only the winner strategies having *J*=12 and *K*≥ 18 present negative returns, approximately -0,034% and -0,003% for strategies (12,21) and (12,24) respectively. The winners with better performance are strategies (3,1) providing a average monthly return of 0,659%, (3,3) providing 0,569% average monthly return, and (6,1), (9,3) providing respectively 0,567% and 0,504%.

The strategy (6,6), the most commonly used in academic research, being the reference in *momentum* literature, contrarily from we expected, provides a return of only 0,377%. This strategy clearly outperforms PSI-20, and PSI-Geral but considering short term holding period strategies, provides the lowest return.

As for losers, we verify the effect observed for Cerqueira, A. and Brandão, E. (2008) for is sample period 2000 a 2003 in U.S. market (bear market). The returns of losers strategies are higher than the return provided by winner strategies. In fact, winners monthly average return outperform losers only in (12, 21) and (12, 24). The loser strategies with higher performances are (1,1), (9,1) e (3,9) with average monthly returns of 1,261%, 1,140% and 1,130% respectively. The most efficient strategies always have J≤ 6 and K≤ 12m except for the strategy (9,1).

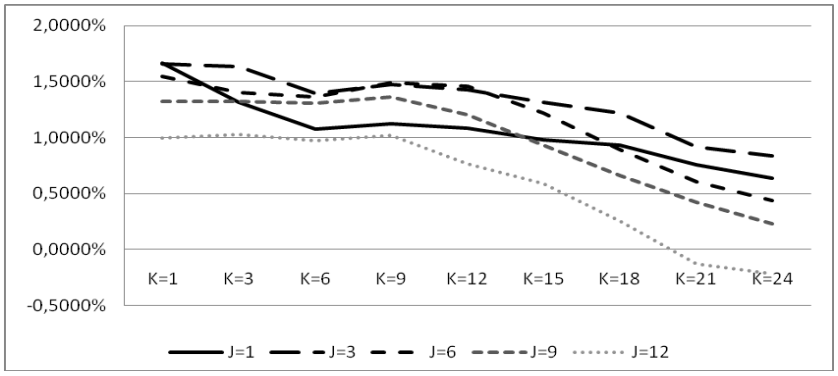
Figure 2 – Average monthly return of JT strategies considering winner and loser stocks for Portuguese market



For both winner and losers, the most efficient strategies are also the short term strategies. Only for J=1 and J=3 we verify a slightly improvement in returns performance for K>12, but even for both strategies, the returns of holding periods of 1 and 3 months are higher. We also notice that the loser strategies graphic designs are all similar, (except for J=24, with returns decreasing faster than others as long as the holding period becomes bigger) they all behave in a similar way as long as the holding period becomes bigger.

The winner strategies behaviour is not that consistent. With holding periods J=9 and J=24 behaving slightly diferent, rapidly increasing the profitability till K=9, and then decreasing. And, as mentioned before, with J=1 and J=3 maintain the profitability for K>12.

Figure 3 – Total average monthly return of JT strategy for Portuguese stock market



As we can see, following JT's methodology, the portfolios providing the higher average monthly returns are the ones based on historical data from last 3, 6 and 9 months and holding

them for less than a year. We observe a decreasing on returns when formation and holding periods are over one year.

3.2.2. GEORGE, T. AND HWANG, C. (2004) (52-WEEK HIGH).

The procedure of picking the 52-week high strategy is similar of JT strategy presented above. The only difference is in the way the stocks are ranked. Stocks are ranked accordingly to:

$$\frac{P_{i,t-1}}{high_{i,t-1}}$$

Where $p_{i,t-1}$ is the price of stock *i* at the end of month *t-1* and $high_{i,t-1}$ is the highest price value in the last 52 weeks.

Investments in portfolios are managed accordingly to the distance from stock market price to the highest value of the last 52 weeks, (going long on the stocks ranked in the 10% with smaller distance and short selling the ones ranked in the 10% with higher distance to the 52 week high), and holding them for *K* months, K = {1, 3, 6, 9, 12, 15, 18, 21, 24}. These portfolios provide abnormal returns, outperforming market. However, with average monthly returns lower than the ones provided by JT strategy.

We also find that the loser strategies provide higher returns than the winners, except when stocks are hold for more than two years. All strategies provide positive average monthly returns and for K≤18 those returns are higher than 1%.

Table 3 - Average monthly return provided for George, T. and Hwang, C. (2004) strategy in the Portuguese stock market from 01/01/2000 to 31/12/2009. The strategy consists in going long on the 10% top performer stocks (winner) and short sells the 10% bottom performers, according to a ranking of returns considering the distance to the maximum value in the last 52 weeks and holding the portfolios for K months.

K=	Winner (W)	Loser (L)	Total return W+L
1	0.26%	1.00%	1.26%
3	0.32%	1.10%	1.42%
6	0.29%	0.98%	1.27%
9	0.36%	1.06%	1.42%

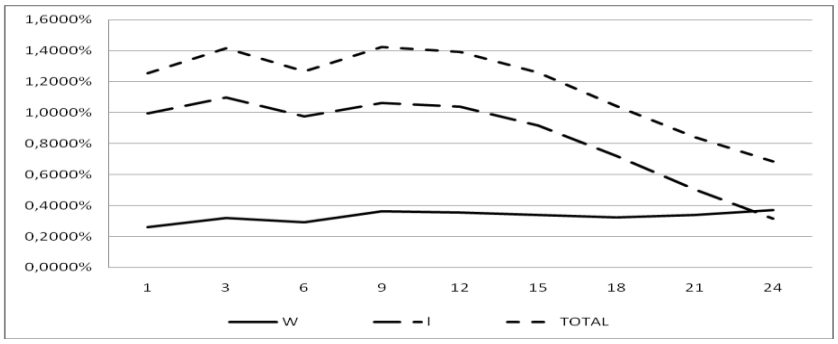
12	0.36%	1.04%	1.39%
15	0.34%	0.92%	1.26%
18	0.32%	0.72%	1.04%
21	0.34%	0.51%	0.84%
24	0.37%	0.31%	0.68%

Every winner strategy outperform both PSI-20 and PSI-Geral but, contrary than expected, the average monthly return of winners increases as the holding period becomes longer. The most efficient winner strategy is long term strategy K=24, providing an average monthly return of 0,369%, while K=1 provides a return of only 0,260%.

Considering loser strategies, we find that they are close to 1% for K≤15, and decrease afterwards. As in JT, the profitability of 52 WH is determined by loser's profitability. The returns of losers are always higher than the returns of winners, except for K=24. For K=1, K=3 and K=6 loser returns are more than 3 times higher than the winner returns.

For K≤ 15, the total returns of the strategies provide average monthly returns between 1,256% and 1,422% (for K=1 and K=9 respectively) and exhibit reversal for K>15.

Figure 4 - Total average monthly return of 52 WH strategies for Portuguese stock market



Contrary to JT, were the set (J,K) maintains same the graphic configuration either it is a winner or a loser, for 52 week high strategies we find that the configuration of returns along the investment time term are almost the opposite in terms of efficiency. The most profitable strategies in JT are short term strategies, with formation and holding periods till one year, either they are winner or loser portfolios. Considering the 52 week high we find that for winners, the most profitable strategies have K>6 while most profitable losers have K<12.

When comparing with JT strategies, we find that for every investment time horizon JT strategy always provide higher returns than 52 week high strategy. For example, considering

an investment horizon of one month, investor should consider a JT strategy formed from one month historical data. While for an investment term of six months, he should consider JT strategy with formation period of three months.

Table 4 – Comparison of global average monthly returns for each JT and 52 WH strategies

Jegadeesh e Titman (1993) (JT)

	K - HOLDING PERIOD								
J	K=1	K=3	K=6	K=9	K=12	K=15	K=18	K=21	K=24
1	**1.6667%**	1.3160%	1.0748%	1.1250%	1.0822%	0.9818%	0.9342%	0.7587%	0.6377%
3	1.6576%	**1.6358%**	**1.3943%**	1.4711%	1.4270%	**1.3136%**	**1.2212%**	**0.9168%**	**0.8340%**
6	1.5445%	1.4011%	1.3653%	**1.4890%**	**1.4581%**	1.2228%	0.8912%	0.6053%	0.4376%
9	1.3268%	1.3229%	1.3092%	1.3652%	1.2013%	0.9342%	0.6636%	0.4192%	0.2275%
12	0.9932%	1.0313%	0.9733%	1.0224%	0.7684%	0.5925%	0.2502%	-0.1249%	-0.2153%

George e Hwang, (2004) (52-week high)

K - HOLDING PERIOD								
K=1	K=3	K=6	K=9	K=12	K=15	K=18	K=21	K=24
1.2556%	**1.4172%**	**1.2650%**	**1.4222%**	**1.3938%**	**1.2567%**	**1.0418%**	**0.8432%**	**0.6832%**

3.2.3. LO, A. AND MACKINLAY, C. (1990) (LM) STRATEGY

We follow Du, D. (2009)'s industry *momentum* methodology using the Lo, A. and Mackinlay, C. (1990) adapted to a *momentum* strategy. The strategy consist in investing in all assets available in the market, buying all the stocks with positive returns in formation period and short selling all the stocks with negative returns in the formation period. The weight of each stock in the portfolio in week *k* is given by:

$$w_{it}^{\iota}(k) = \frac{1}{N}(r_{i,t-1}^{\iota} - r_{m,t-1}^{\iota}) \qquad i = 1,2\ldots,N$$

Were *i* represent the stock, *N* the total number of stocks in the portfolio, $r^{\iota}_{i,t-1}$ return of *i* in *t-1* during the ι weeks and , $r^{\iota}_{m,t-1}$ represents the average return of all sample stocks during ι weeks. ι Equals one when considered the weekly return, till 26 when considered the six months return. By definition, the sum of all $w^{\iota}_{it}(k)$ equals zero. As all weights in the portfolio are proportional to the distance between individual returns to market return, those with biggest difference to market in *t-k* are heavily weighted in the portfolio, and vice-versa.
We considered the closing price on every Wednesday, when not available, it will be considered on the previous available day.

The strategy consists in investing in all available assets in the market, not only the extremes.

It consists on going long on winners and short selling losers, with the weights accordingly to (4). The bigger the difference of the stock past returns to market return, the bigger the weight in the *momentum* portfolio.

In order to facilitate comparison of LM strategy with JT and 52WH strategy, we will consider same time term for LM strategy corresponding to JT and

Table 5 – Correspondence between JT and 52 WH monthly formation and holding terms to LM weekly formation and holding terms

Months	Formation	J	1	3	6	9	12	15	18	21	24
	Holding	K									
Weeks	Formation	ι	5	13	26	39	52	65	78	91	104
	Holding	k									

As expected, this strategy points out to the existence of *momentum* in short term. We also found that returns exhibit reversal, as we can see in table 7. As we expected the most profitable weeks have formation periods ι between 13 and 39 weeks and holding periods till 52 weeks. These results are consistent with our previous findings that *momentum* most efficient strategies are based on past performance of the last 3, 6 and 9 months and holding portfolios for less than one year.

Table 6 - Average monthly returns provided for Lo, A. and Mackinlay, C. (1990) strategy in the Portuguese stock market from 01/01/2000 to 31/12/2009, considering formation and holding periods over 4 weeks. The strategy consists in going long on every past winner available stocks and short sells all available loser stocks, according to the historical data formation period of ι weeks and holding the portfolios for k weeks.

	ι= 5	**ι=13**	**ι=26**	**ι=39**	**ι=52**
k=5	2.216%	4.958%	8.310%	7.541%	7.843%
k=13	1.798%	5.175%	6.012%	6.109%	6.895%
k=26	1.517%	2.850%	3.471%	4.199%	4.016%
k=39	0.804%	1.947%	3.059%	3.573%	3.030%
k=52	0.816%	2.158%	3.435%	3.676%	2.589%
k=65	0.980%	2.107%	2.869%	2.526%	1.820%
k=78	0.610%	1.258%	1.442%	1.017%	0.125%

k=91	0.263%	0.598%	0.476%	-0.175%	-1.724%
k=104	0.113%	0.291%	0.029%	-1.036%	-2.770%

This strategy clearly outperforms the George, T. and Hwang, C. (2004) and the Jegadeesh, N. and Titman, S. (1993) strategies. There are seven different combinations of formation and holding periods above 5% average monthly return. The most profitable (ι=26 and k=5) provides an average monthly return of 8,31%, against 1,67% in JT and 1,42% in 52 WH. The most efficient strategies have $13 \leq \iota \leq 52$ and $5 \leq k \leq 26$. We verify that with k > 26 the returns gradually decrease, especially for holding period larger than 18 months (k >78), being negative in the long run. In the long run, returns exhibit reversal in Portuguese stock market.

If we consider the sum of formation and holding period (ι+k), we find that LM returns generally start to decrease when it becomes bigger than 91 or 104 weeks, corresponding to 21 or 24 months, when it becomes larger than 18 months.

Du, D. (2009) finds that industry returns do not exhibit reversal in U.S. sample in first week. This conclusion is contrary to Lewellen, J. (2002), for individual stocks. Consistent to Lewellen, J. (2002), we find that considering the Portuguese sample, the individual returns do exhibit reversal in first week. This may be due to either microstructure issues or firm specific risk Du, D. (2009). It would be helpful to consider industry *momentum* for Portuguese market, to verify the behaviour of *momentum* for industry portfolios, but due to the reduced number of stocks, the industry portfolios would not diversify, nor the microstructure issues, nor firm specific risk. The results from formation period ι = 5 are smaller than the ones with longer formation periods. The predictive power of historical data up to one month is lower than 3, 6 or 9 months of historical data.

This findings are opposites to Du, D. (2009), were the predictive power of weakly returns are bigger than six months returns for the U.S. market. In the Portuguese market, considering all sample period, the weakly returns have low predictive power, and in first week returns do exhibit reversal. As we can observe, considering an investing term of one week with formation period of one week, will origin a loss of 1,39% average monthly return. After this combination, the results are always positive, but not as high as reported in a previous table.

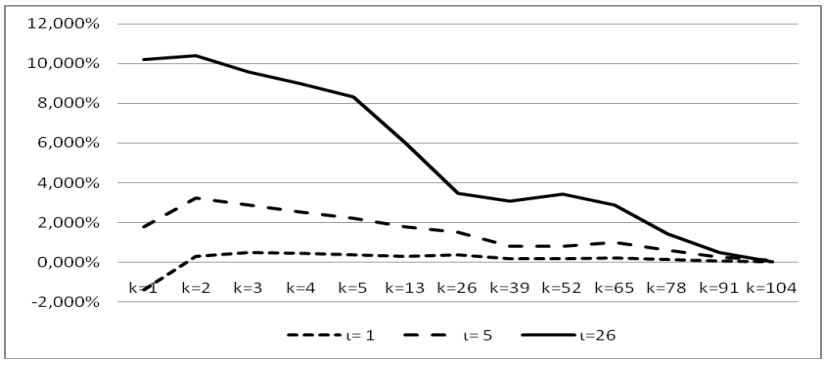
Table 7 - Average monthly return provided for Lo, A. and Mackinlay, C. (1990) strategy in the Portuguese stock market from 01/01/2000 to 31/12/2009, considering formation and holding periods from 1 to 4 weeks. The strategy consists in going long on every past winner available

stocks and short sells all available loser stocks, according to the historical data formation period of ι weeks and holding the portfolios for k weeks.

	ι= 1	ι=2	ι=3	ι=4
k=1	-1.395%	0.600%	1.465%	1.890%
k=2	0.299%	1.763%	2.386%	2.543%
k=3	0.489%	1.603%	1.964%	2.571%
k=4	0.469%	1.279%	1.934%	2.323%

In figure 5 we can observe that LM *momentum* returns, considering Portuguese individual stocks, always reverse, no matter we consider one week formation period (short term in Du, D. (2009)), five weeks formation period or 26 weeks formation period (long term in Du, D. (2009)). We can clearly observe that considering 26 past week returns provides much higher returns than one week past return.

Figure 5 - Total average monthly return of LM strategies for Portuguese stock market



4. CONCLUSION

We confirm that the Portuguese stock market shows evidence of *momentum* anomalies, which allows investors to outperform the reference indexes, confirming the works of Soares, J. and Serra, A. (2005), and Pereira, P. (2009). From 2000 to 2009 the tested *momentum* strategies of Jegadeesh and Titman (1993), George and Hwang (2004) and Du (2009) provided a monthly average return of 1,667%, 1,422% and 8.310% respectively, while the reference index (the PSI-20) retracted more than 0,35% in monthly average terms.

The *momentum* returns last for over two years and approach zero afterwards, consistent with the short horizon under-reaction theory, investors tend to underestimate news, causing

autocorrelation on returns in short term. This slowly movement toward the equilibrium lasts for two years being corrected afterwards.

Following the methodologies Jegadeesh and Titman (1993), George and Hwang (2004) and Du (2009), our results do not take into account custody costs or transaction costs. The *momentum* investing strategies are trade intensive and transaction costs might create a no-arbitrage band which would neutralize *momentum* returns. It would be interesting to verify the effect transaction cost and custody costs have in the *momentum* investing returns, and if the strategies do beat the market. That can be a possible development of the present work.

We found evidences that investing strategies based in the assumption that stock prices tend to follow a path, do provide abnormal returns. This conclusion is contrary to the random walk hypothesis for the Portuguese stock market.

5. BIBLIOGRAPHY

Barberies, N. and Thaler, R. (2002): "A Survey of Behavioural Finance, Handbook of the Economics of Finance", NBER Working Paper No. 9222, September.

Borges, M. (2008): "Efficient Market Hypothesis in European Stock Markets", School of Economics and Management - Technical University of Lisbon, Draft Version, April.

Cahan, R. (2008): "An Investigation into the Strength of the 52-week high *Momentum* Strategy in the United State", New Zealand: Massey University, Master Dissertation in Finance.

Cerqueira, A. and Brandão, E. (2008): "Alternative *Momentum* Strategies. 5th Finance Conference - Portuguese Finance Network", Coimbra: Faculdade Economia Universidade de Coimbra.

Correia, R. (2009): "Testing information efficiency in the Portuguese stock market", Instituto Superior de Ciências do Trabalho e da Empresa, Instituto Superior de Ciências do Trabalho e da Empresa – Instituto Universitário de Lisboa, May, Master Dissertation in Finance.

Du, D. (2009): "*Momentum* and Reversals in Industry Portfolio Returns." International Research Journal of Finance and Economics, ISSN 1450-2887 Issue 33.

George, T. and Hwang, C. (2004): "The 52-Week High and *Momentum* Investing." The Journal of Finance 59: pp: 2145-2176.

Grinblatt, M. and Han, B. (2001):"The Disposition Effect and *Momentum*", UC Los Angeles: Anderson Graduate School of Management, http://www.escholarship.org/uc/item/6qg5d62p

Grinblatt, M. and Moskowitz, T. (1999): "Do Industries Explain *Momentum*?" The Journal of Finance 54: 1249-1290.

Jannen, B. and Pham, V. (2009): "52 Week High and *Momentum* Investing: A Partial Replication of George and Hwang's Results", http://kanecap.com/doc/williams/econ18/2009/Jannen_Pham_Econ18_2009.pdf

Jegadeesh, N. and Titman, S. (1993): "Returns to buying winners and selling losers: Implications for market efficiency" Journal of Finance 48: 65-91.

Lewellen, J. (2002): "*Momentum* and Autocorrelation in Stock Returns", Review of Financial Studies 15, pp. 533 – 564.

Lo, A. and Mackinlay, C. (1990): "When Are Contrarian Profits Due to Stock Market Overreaction?" Review of Financial Studies 3: 175-205.

Nascimento, V. (2007): "Eficiência Informacional do Mercado de Acções: O Caso Português", Faculdade de Economia da Universidade do Porto, Master Dissertation in Finance.

Nijman, T., Swinkels, L. and Verbeek, M. (2004): "Do Countries or Industries Explain *Momentum* in Europe" Journal of Empirical Finance 11: pp. 461-481.

Pereira, P. (2009): "*Momentum* and Contrarian Strategies in the Portuguese Stock Market", Lisboa: ISCTE Business School, Master Dissertation in Finance.

Romacho, J. and Cidrais V. (2007): "A Eficiência do Mercado de Capitais Português e o Anúncio dos Resultados Contabilísticos", Revista de Estudos Politécnicos, 2007, Vol IV, n.° 7, 235-252.

Rouwenhorst, K. (1998): "International *Momentum* Strategies", Journal of Finance 53 , 267–284.

Simão, J. (2000): "Algumas propriedades estatísticas da rendibilidade de títulos da Bolsa de Valores de Lisboa: um estudo empírico", www.ine.pt. http://www.ine.pt/xportal/xmain?xpid=INE&xpgid=ine_estudos&ESTUDOSest_boui=106066&ESTUDOSmodo=2

Smith, G. and Ryoo, H. (2003): "Variance ratio tests of the random walk hypotheses for European emerging markets", The European Journal of Finance 9, pp: 290-300.

Soares, J. and Serra, A. (2005): "Overreaction and Underreaction: Evidence for the Portuguese stock market", Cadernos de Valores Mobiliários 22, Faculdade de Economia da Universidade do Porto, March.